RFA # EPA-OAR-OAQPS-21-03
Attachment 6-A
Development, Demonstration and Certification of 10-Liter Natural Gas Engine Project
Emissions Inventory Analysis Attachment

(1-B) Analysis of Emissions Inventory

The Final 2016 South Coast AQMD's Air Quality Management Plan (AQMP or Plan), a regional blueprint for achieving air quality standards and healthful air, has identified the need for nitrogen oxide (NOx) emission reductions as the most significant air quality challenge in meeting the upcoming ozone standard deadlines. Based on the Plan analysis of emissions, meteorology, atmospheric chemistry, regional growth projections, and the impact of existing control measures, continued implementation of already adopted regulatory actions is insufficient to meet the ozone standards. Total SCAB emissions of NOx must be reduced by an additional 45% by 2023, and an additional 55% by 2031 to achieve attainment. Since NOx emissions also lead to the formation of PM2.5, the NOx reductions needed to meet the ozone standards will also lead to attainment of the PM2.5 NAAQS. Therefore, in order to achieve any substantive progress toward the SCAB's air quality goals, South Coast AQMD needs a combination of stringent regulations, advanced low- and zero-emission technologies and incentive funds to assist fleets replace their older and dirtier diesel on-road and off-road vehicles and equipment with newer and cleaner low- and zero-emission technologies.

The most significant air quality challenge in the SCAB is to reduce NOx emissions sufficiently to meet the upcoming ozone standard deadlines. Based on the inventory and modeling results of the 2016 AQMP, 522 tons per day (tpd) of total Basin NOx 2012 emissions are projected to drop to 255 tpd and 214 tpd in the 8-hour ozone attainment years of 2023 and 2031 respectively, due to continued implementation of already adopted regulatory actions ("baseline emissions"). The analysis suggests that total SCAB emissions of NOx must be reduced to approximately 141 tpd in 2023 and 96 tpd in 2031 to attain the 8-hour ozone standards. This represents an additional 45 percent reduction in NOx in 2023, and an additional 55 percent NOx reduction beyond 2031 levels. **Figure 1** presents the future projections of NOx emissions, the reductions from the proposed control strategy and the levels necessary to attain the standards. The figure also illustrates how the strategy to meet the 8-hour ozone standard in 2023 should lead to sufficient NOx emission reductions to attain the 1-hour ozone standard by 2022. Since NOx emissions also lead to the formation of PM2.5, the NOx reductions needed to meet the ozone standards will likewise lead to improvement of PM2.5 levels and attainment of PM2.5 standards.

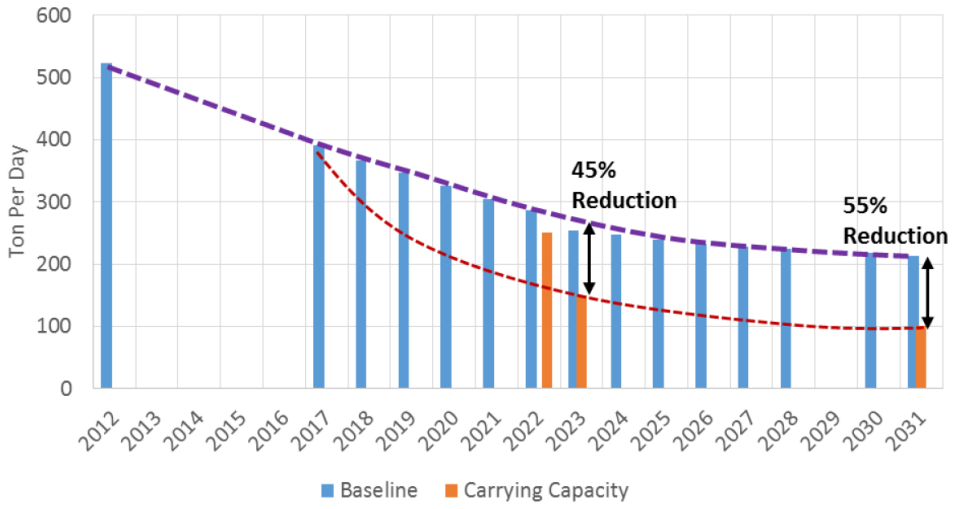

Figure 1 SCAB NOx Inventory Data, 2016 AQMP

The 2016 AQMP eliminates a reliance on future unknown and unspecified technology measures to meet the attainment of the NAAQS, to the maximum extent feasible. This is due to the belief that the majority of zero emission and near-zero emission technologies required for fast approaching attainment deadlines as early as 2022 and 2023 already commercially available or will soon be commercially available. Hence it is possible to specify technology and implementation pathways to attainment. It is understood that the 2016 AQMP some Clean Air Act §182(e)(5) flexibility by U.S. EPA given the need for continued technology and cost effectiveness, as well as new funding and incentive programs. A list of attainment of five NAAQS are show below:

Table 1: 2016 South Coast AQMD NAAQS Attainment Dates

Standard	Concentration	Classification	Latest Attainment Year
2008 8-hour Ozone	75 ppb	Extreme	2031
2012 Annual PM2.5	12 µg/m³	Moderate Serious	2021 2025
2006 24-hour PM2.5	35 µg/m³	Serious	2019
1997 8-hour Ozone	80 ppb	Extreme	2023
1979 1-hour Ozone	120 ppb	Extreme	2022

The 2016 AQMP also takes credit for co-benefits from other local, state and federal efforts addressing GHG reductions, energy efficiency, transportation, and goods movement, which will lead to further air quality improvements. Due to South Coast AQMD's limited authority to regulate mobile sources in the South Coast Air Basin, attainment cannot be achieved without state and federal actions. Proposed measures include a new ultra-low NOx federal engine emission standard for heavy-duty trucks and CARB mobile source regulations including the Advanced Clean Trucks, Truck and Bus Regulation, Innovative Clean Transit, Zero-Emission Airport Shuttle, Drayage Truck, Cargo Handling Equipment, and Fleet Reporting regulations.

Another strategy outlined in the 2016 AQMP is to identify and secure additional funding to implement early deployment and early commercialization of zero and near-zero emission technologies in the mobile source category including medium- and heavy-duty trucks, transit buses, and cargo handling equipment such as yard tractors, top handlers, RTG cranes, and ocean going vessels. The 2016 AQMP prioritizes maximizing emission reductions by utilizing zero emission technologies wherever feasible and cost effective near-zero emission technologies in other applications, when a regulatory approach is not yet practical or would require more time to achieve near-term emission reductions required to meet the NAAQS. A full life cycle emissions analysis will be considered in determining the full emissions profile and cost effectiveness of zero and near-zero emission technologies. There will be special consideration of strategies contributing to the economic vitality of the region, needs of the public and small businesses, and maximizing emission reductions in Environmental Justice or Disadvantaged Communities.

The overall strategy for the 2016 AQMP is a combined approach including stationary and mobile source emission reductions from regulatory control measures; incentive based programs; co-benefits from climate change, mobile source strategies and reductions from state (vehicles and cargo handling equipment) and federal sources (aircraft, locomotives, ocean going vessels). This combined approach for the 2016 AQMP is shown below. Since mobile sources comprise 88 percent of the total NOx emissions in the South Coast Air Basin for 2012, the focus for the South Coast AQMD proposals for the 2021 EPA Targeted Airshed Grant solicitation will be on battery electric heavy-duty trucks; hydrogen fuel cell heavy-duty trucks, near-zero emission natural gas long-haul heavy-duty trucks, battery electric school buses; battery electric locomotive, battery-electric low and garden equipment, as well as battery electric TRUs.

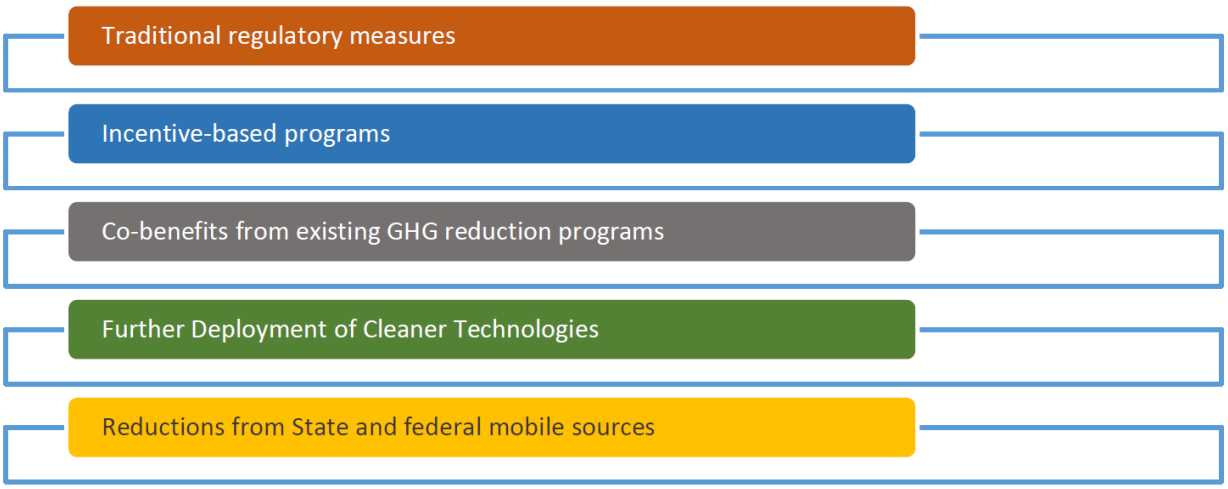

Figure 2 2016 AQMP Overall Strategy.

The two projects in this application will help address emissions from numerous relevant source categories. Table below lists control

measures from the 2016 South Coast Air Quality Mitigation Plan (AQMP) which will be affected by the deployment of battery electric trucks as part of this project. In addition to the immediate emission reductions and community engagement effects of this deployment, this project is poised to serve as a catalyst for the accelerated penetration of zero emission technologies throughout the South Coast Air Basin.

Table 2: 2016 South Coast AQMD AQMP Air Quality Attainment Measures[1]

AQMP Measure	Project Relationship
MOB-03: Emission Reductions at Warehouse Distribution Centers	Replacement of older diesel distribution trucks with new Class 6 battery electric trucks will result in NOx and PM 2.5 emission reductions from displaced diesel vehicles at distribution centers in the South Coast Air Basin, particularly in the DACs of locations mentioned in Error! Reference source not found. above,
MOB-05: Accelerated Penetration of Partial Zero-Emission and Zero Emission Vehicles	This project will add to the deployment of zero emission delivery and goods movement at DACs in the South Coast Air Basin. It will serve as a proving ground for Class 6 battery electric trucks in distribution, short haul, and service applications. In addition, the project partners are best positioned to push the market forward by leveraging existing connections and serving as model fleet sites in zero emission delivery applications.
MOB-07: Accelerated Penetration of Partial Zero-Emission and Zero Emission Light-heavy and Medium-heavy-duty vehicles	Commercial deployment of the production level Xos truck platform to the market will increase options for fleets facing compliance deadlines for upcoming CARB regulations and are in the market for new vehicles to begin meeting regulatory deadlines. Without earlier movers like Loomis, fleets are hesitant to trust new technologies for medium-duty trucks. This project will validate the technology on a wider scale so that fleets may confidently make the switch to zero emission medium-duty technologies and facilitate a price drop with increased adoption.
MOB-08: Accelerated Retirement of Older On-Road Heavy-duty Vehicles	With a viable zero emission truck on the market, fleets will be encouraged to retire their older diesel trucks. Fleets waiting for a commercially available zero emission Class 6 truck option will now have access to these trucks. Certification of these trucks through the CARB zero emission powertrain certification process and qualification for incentive funding such as HVIP, VW Settlement, Carl Moyer, and Prop 1B will reduce the price differential to fleets and make zero emission trucks more affordable. Outreach on the benefits of these technologies to residents and businesses in DACs will increase technology visibility and promote more sustainable policies for local governments in DACs.

Lastly, these projects will directly support the EPA's Strategic Plan as well as South Coast AQMD's 2016 AQMP. South Coast AQMD and its project partners created its scope with the sole purpose of reducing emissions using new technologies that allow the same mode of operation without using diesel fuel. This project directly supports EPA's Strategic Plan - Goal 1, Objective 1.1: "Improve Air Quality" by directly improving the air quality where millions of southern Californians live and work. Given that the South Coast Air Basin has exceeded the established standards for healthy air on numerous documented occasions, this project puts South Coast AQMD in partnership with the EPA to support the attainment of the NAAQS by way of deploying electric vehicles. The project will result in the direct reduction of NOx, ozone, and particulate matter and will enhance the market for clean fuel technologies.

Class 8 Heavy-Duty Truck Analysis

[1] South Coast AQMD, 2016 Air Quality Management Plan, http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan.

Mobile sources emit a large portion of NOx and PM2.5 emissions in the SCAB, and heavy-duty category operation within urban population centers, have adverse impact on air quality and public health, particularly in EJ communities which are disproportionately impacted by emissions of ozone precursors, toxic air contaminants and greenhouse gases from heavy diesel traffic along the goods movement corridors (I-5, I-10, I-60, I-101, I-605, and I-215), as well as diesel goods movement activities at ports and rail yards. Table below lists the key air pollutant inventories, based on CARB 2016 State Implementation Plan (SIP) Emission Projection Data for heavy-duty trucks in the SCAB. Emissions from these listed categories account for 20% of ozone precursors and PM 2.5 in the SCAB. However, with recent implementation of CARB Truck and Bus regulation, the number of 2010+ new and used diesel trucks are expected to increase due to its lower cost compare to other replacement options as well as population and economy continue to grow. As pervious in-use emission studies have shown, significantly higher NOx emissions from medium- and heavy-duty on-road diesel vehicles than the certification limit under certain in-use operations, such as low power duty cycles here in the SCAB.

Figure 3. Governor Newson EO N-79-20, from CARB MSS.

Table 3. 2020 SIP Emission Projection Data (CARB) tons/day

Category	VOC	NOX	PM2.5	CO
LIGHT HEAVY-DUTY GAS TRUCKS - 1	3.44	4.28	0.12	13.67
LIGHT HEAVY-DUTY DIESEL TRUCKS - 1 (LHDDT1)	0.30	8.81	0.18	2.02
MEDIUM HEAVY-DUTY DIESEL TRUCKS (MHDDT)	0.57	16.01	0.76	2.02
HEAVY HEAVY-DUTY DIESEL TRUCKS (HHDDT)	1.50	55.51	0.63	8.66

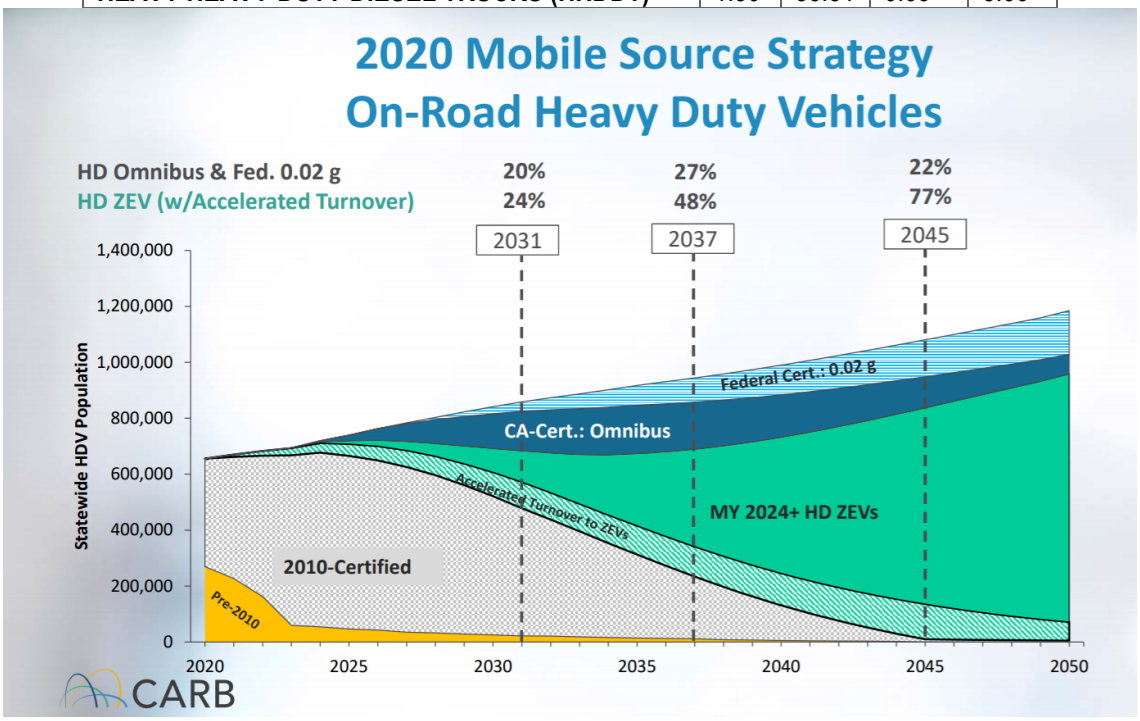

Figure 3 Technology mix for heavy-duty vehicles as presented ins CARB MSS.

2020 CARB Mobile Source Strategy (MSS) set forth boundaries set by Governors' Executive Order N-79-20, as shown in Figure 3. Note that the EO specific separate out short=haul/drayage trucks and heavy-duty long-haul trucks with timing delayed by a decade which shows the barriers for overcoming range and refueling requirements. The technology mix are also suggesting similar story. As shown in **Figure 3**, for near team, through 2031, nearly 75% of heavy-duty vehicles will be still internal combustion, long-haul truck data is not available, but SCAQMD estimates diesel trucks makes up the majority due to slow build out of public infrastructure. Therefore, a wide

scale early deployment of near-zero trucks in this segment will prove reduce the share of 2010-Certified diesel trucks which emits much higher NOx than 0.2 g/bhp-hr in-use. The proposed project and other pending and existing near-zero emission trucks will result in significant reduction in ozone and PM2.5 emissions by South Coast AQMD collaborating with: 1) Partnering with both small and large OEMs to accelerate the technology development, 2) large private fleets in different vocations to demonstrate this technology and 3) federal and state agencies to provide incentive funds to cover the incremental cost of replacing diesel with near-zero emission trucks. As stated in the narrative the use of RNG, the added operational flexibility from the more power engine, as well as other regulatory programs such as WAIRE program provide future demand for near-zero emission natural gas trucks. Also shown in Table 3 below, combustion based measures, such as HD Omnibus, EPA CTI, Heavy-Duty I/M provides the most significant NOx reductions for SCAB for both 2023 and 2031.

Table 3. 2020 MSS Potential Near-term NOx Reductions from various programs (tons per day).

Measures	Adoption	Implementation	South Coast 2023	San Joaquin Valley 2024	South Coast 2031
Advanced Clean Cars II	2022	2026	0	0	3.2
ACT and HD Omnibus	2020	2024	<0.1	<0.1	7
U.S. EPA CTI	2021	~2027	0	0	4
Heavy-Duty I/M	2021	2024	3.5	11	18
Zero-Emission Drayage and Advanced Clean Fleet*	2021	2023	0	<0.1	6-10
Ocean Going Vessels At Berth	2020	2024	1.1	<0.1	3.6
Small Off-Road Engines	2021	2024	0	<0.1	2.8
Transport Refrigeration Unit	2021	2024	0	<0.1	0.4
In-Use Locomotive*	2022	2024	0	0.4	7
Commercial Harbor Craft*	2021	2023	0.9	<0.1	2.9
Zero-Emission Forklift	2022	2025	0	0	3.7
Cargo Handling Equipment*	TBD	TBD	0.1	<0.1	0.9
Construction & Mining*	TBD	TBD	<0.1	<0.1	3.4
TOTAL			**5.6**	**11.4**	**63-67**